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1 452 524

PATENT SPECIFICATION

(11) 1 452 524

(21) Application No. 58943/73 (22) Filed 19 Dec. 1973
(31) Convention Application No. 2261995
(32) Filed 19 Dec. 1972 in
(33) Germany (DT)
(44) Complete Specification published 13 Oct. 1976
(51) INT CL² E21B 19/16 B23P 19/00
(52) Index at acceptance
E1F 31A
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(19)

(54) DEVICE FOR ROTATING OR TWISTING A PIPE

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a casing pipe for boreholes, by means of a gear-toothed partial ring coupled to a driving pinion, the ring partially surrounding the pipe and being located between two plates, both having an opening of similar diameter to and coaxial with the ring. Clamping jaws are arranged on the plates and are movable radially by means of cams on the inside of the ring into clamping engagement with the pipe.

It is known to arrange to the clamping jaws on a closed ring-shaped member which is engaged by a drive device. A closed ring-shaped member can, however, only be moved in an axial, but not a radial, direction in relation to the pipe, so that it is not possible to effect a lateral mounting or dismounting of the device, in consequence of which the field of use of the device is limited.

In order to render the rotational drive device capable of being moved laterally relative to a pipe upon mounting and diamounting a known method is to place the clamping jaws in a split ring. Such a device, however, permits the application of only relatively small torques to a pipe, since the split ring would otherwise expand. Alternatively a complex construction of the housing for the clamping jaws would be necessary, in order to avoid such expansion. Furthermore in known pipe driving devices special means, partly hand-operated, are necessary for changing the direction of the torque applied to the pipe.

In order to bring radially movable clamping jaws into and out of engagement

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applied to a pipe by previously known methods or alternatively, for a given torque, allows the use of a simple drive device. Additionally, it is desirable that the device should be able to turn a pipe in both directions without the need for any additional steps, such, for example, as turning the whole mechanism around, or manual manoeuvering of its parts. At the same time, automatic connection to a pipe, which is connected to automatic centering means for the whole system, should be possible.

According to this invention there is provided a rotational drive device for rotating a pipe, for example, a casing pipe for bore-holes, comprising a ring gear coupled to a driving pinion, the ring gear having a cut-out portion and being disposed between two annular guide plates coaxial with said ring gear each of which has a cut-out portion of the same width as that of the ring gear, clamping jaws adapted to grip the pipe and guided for movement radially between the guide plates, cams arranged on the inside of the ring gear for displacing the clamping jaws radially relative to the guide plates, each cam and respective clamping jaw cooperating therewith being displaced axially relative to the or each other cam and respective clamping jaw so that each cam can only come into contact with its associated clamping jaw, and means for centering the pipe within the ring gear with the cut-out portions of the ring gear and the guide plates aligned with each other, and the ring gear being rotatable relative to the guide plates, in either direction of rotation,

ERRATUM

SPECIFICATION No. 1,452,524

Page 3, line 36, *delete* 38 *insert* 39

THE PATENT OFFICE
20th December, 1976

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(54) DEVICE FOR ROTATING OR TWISTING A PIPE

(71) We, WEATHERFORD OIL TOOL GMBH, a German company, of 3001 Krähenwinkel, Hainhäuser Weg 190, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns a rotational drive device for rotating a pipe, for example a casing pipe for boreholes, by means of a gear-toothed partial ring coupled to a driving pinion, the ring partially surrounding the pipe and being located between two plates, both having an opening of similar diameter to and coaxial with the ring. Clamping jaws are arranged on the plates and are movable radially by means of cams on the inside of the ring into clamping engagement with the pipe.

It is known to arrange to the clamping jaws on a closed ring-shaped member which is engaged by a drive device. A closed ring-shaped member can, however, only be moved in an axial, but not a radial, direction in relation to the pipe, so that it is not possible to effect a lateral mounting or dismounting of the device, in consequence of which the field of use of the device is limited.

In order to render the rotational drive device capable of being moved laterally relative to a pipe upon mounting and diamounting a known method is to place the clamping jaws in a split ring. Such a device, however, permits the application of only relatively small torques to a pipe, since the split ring would otherwise expand. Alternatively a complex construction of the housing for the clamping jaws would be necessary, in order to avoid such expansion. Furthermore in known pipe driving devices special means, partly hand-operated, are necessary for changing the direction of the torque applied to the pipe.

In order to bring radially movable clamping jaws into and out of engagement with a pipe it is necessary to effect simultaneous movement of the jaws to keep the pipe accurately centred in the device. Known methods for doing this are difficult and laborious, involving the holding of the pipe by a manual gripping tool until the pipe is fixed and centered with the clamping jaws in engagement with the pipe.

An object of this invention is to provide a rotational drive device which allows the application of higher torques than could be applied to a pipe by previously known methods or alternatively, for a given torque, allows the use of a simple drive device. Additionally, it is desirable that the device should be able to turn a pipe in both directions without the need for any additional steps, such, for example, as turning the whole mechanism around, or manual manoeuvering of its parts. At the same time, automatic connection to a pipe, which is connected to automatic centering means for the whole system, should be possible.

According to this invention there is provided a rotational drive device for rotating a pipe, for example, a casing pipe for bore-holes, comprising a ring gear coupled to a driving pinion, the ring gear having a cut-out portion and being disposed between two annular guide plates coaxial with said ring gear each of which has a cut-out portion of the same width as that of the ring gear, clamping jaws adapted to grip the pipe and guided for movement radially between the guide plates, cams arranged on the inside of the ring gear for displacing the clamping jaws radially relative to the guide plates, each cam and respective clamping jaw cooperating therewith being displaced axially relative to the or each other cam and respective clamping jaw so that each cam can only come into contact with its associated clamping jaw, and means for centering the pipe within the ring gear with the cut-out portions of the ring gear and the guide plates aligned with each other, and the ring gear being rotatable relative to the guide plates, in either direction of rotation,

until the cut-out portion in the ring gear is displaced by substantially 180° relative to the cut-out portions in the guide plates and a closed rigid ring-shaped structure is formed which is clamped to the pipe by the clamping jaws, whereupon further rotation of the ring gear in the same direction rotates the pipe.

By rotating the ring gear relative to the plates there is achieved, in spite of the cut-out portions, which are displaced by about 180° relative to each other, an effectively closed rigid ring which can be evenly loaded. This ring is of course formed automatically without needing any additional manual means for moving the parts together. The drive device can be brought up and centered on to a pipe to be rotated without requiring excessive manual labour.

The displacement of each cam and respective clamping jaw relative to the or each other cam and clamping jaw ensures that the ring gear can be turned, within the guide plates through 180°, in both directions.

Similarly, in order to make possible automatic rotation of the ring gear in opposite directions, there may be provided a casing having a cut-out portion, the casing being provided on both sides of its cut-out portion with lifting cams each having two inclined cam surfaces facing in opposite circumferential directions, axially displaceable pins arranged in the said plates, and respective bolts axially displaceable in the ring gear by means of the respective pins to release the bolts from engagement with locking elements carried by the guide plates, so as to permit rotation of the ring gear relative to the plates. It is thus possible to disengage the ring gear at any desired place, and to set it turning in the opposite direction until the clamping jaws have again engaged.

Each of the locking elements may comprise a stop bush having one portion which faces in a circumferential direction removed so that the stop bushes are engageable by respective bolts when the associated pins are disengaged from the lifting cam surfaces. In order to permit change of the direction of rotation of the pipe, the stop bushes and the bolts are preferably arranged in cooperating pairs, one pair effecting clockwise rotation of the guide plates and the other pair effecting anti-clockwise rotation of the guide plates, the bolt and bush of each pair having bevelled or cut-out surfaces such that each bolt can ride over the bush of the other pair.

Alternatively, it is possible, in order to achieve the same end, to arrange the lifting cams, and the respective movable pins, bolts and stop bushes associated therewith, at different radial distances from the axis of rotation of the ring gear such that they can pass one another during rotation of the guide plates.

In order to ensure the automatic operation of the whole device it is proposed, according to a preferred embodiment of the invention, that on opposite sides of the cut-out portion of the casing, hydraulically or pneumatically movable centering shutters are arranged for centering the pipe to be driven relative to the ring gear, the plates and the surrounding casing. Each centering shutter is preferably provided with a centering element engageable with the outside of the pipe.

The accompanying drawings illustrate diagrammatically a practical embodiment of the invention, by way of example.

In the drawings:

Figure 1 is a transverse cross-section through the ring gear of a rotational drive device according to the invention, taken on line I—I of Figure 2;

Figure 2 is an axial section taken along line II—II of Figure 1;

Figure 3 is an axial section on an enlarged scale, of part of the drive device, taken on the line III—III of Figure 5;

Figure 4 is an axial section on an enlarged scale of another part of the drive device;

Figure 5 is a cross-section taken along the line V—V of Figure 3, and

Figure 6 is a plan view of an installation incorporating the drive device, with hydraulically operated centering shutters.

Referring to the drawings, an externally toothed ring gear 1 meshes with drive pinions 2. The two annular end faces of the ring gear 1 are located in annular slots 5 (Figure 2) of annular coaxial guide plates 6 which are rotatable about their common axis. Each of the plates 6 has a peripheral cut-out portion 13. In addition the ring gear 1 and a casing 31 enclosing the plates, are also provided with respective cut-out portions of apertures 3 and 40 (Figure 6). Upon its inside surface the ring gear 1 bears two diametrically opposite cams 7a and 7b, against which abut respective cylindrical rollers 8a and 8b carried by radially movable clamping jaws 9a and 9b, located between the guide plates 6. The cams 7a and 7b each have two adjoining ramp surfaces 16a and 16b which lie diametrically opposite each other and ensure accurate centering of the pipe 10 to be rotated in the drive device.

The jaws 9a and 9b have serrated grippers 15 which cooperate with a pipe 10 to be rotated and are slidable in suitable radially extending guides 11 in the guide plates 6. The guide plates 6 are in their turn held by supporting rollers 4 located in annular

supports 12 affixed to the casing 31. The cut-out portion 13 of the plates 6 has the same width as the cut-out portions 3 and 40 of the ring gear 1 and of the casing 31 respectively, this width corresponding to the largest outer diameter of the pipe 10 which is to be rotated.

The annular slots 5 are formed in respective annular channel section liners 5a (Figures 3 and 4).

On opposite sides of the aperture 40 in the casing 31 there are affixed lifting cams 32, 33 (Figures 3 to 5), with which cooperate respective guide or stop pins 36 and 37, the cam 32 and pin 36 being cut away on their radially inward sides with respect to the axis of rotation of the ring gear and the cam 33 and pin 37 being cut away on their radially outward side. The pins 36, 37 are slidable in respective stop bushes 34 and 35 which extend through the lower of the guide plates 6 into an arcuate groove 5b in the floor of the lower annular liner 5a, as shown in Figure 5, the groove 5b extending between the two bushes 34, 35. The bushes 34, 35 have cut away and bevelled portions facing in opposite circumferential directions into the groove 5b. The pins 36 and 37 are lifted by the cams 32, 33 if the cut-out portions 13 in the guide plates 6 coincide with the cut-out portion 40 in the casing 31, and lift drive bolts 38, 39 respectively allowing rotation of the ring gear 1 relative to the guide plates 6. Bevelled cut-away portions of the bolts 38, 38, together with the cut-away and bevelled portions of the stop bushes 34, 35, allow free passage of the bolt 38 past bush 35 and of the bolt 39 past bush 34 in either direction, the bushes 34 and 35 being for this purpose located at slightly different distances from the axis of rotation of the ring gear 1, as shown in Figures 3 and 4.

Upon applying a torque to the pipe 10 in either a clockwise or anti-clockwise direction the cut-out portions 3, 13, and 40 of the ring gear 1, the guide plates 6 and the casing 31 are moved out of register with each other. In order to bring these cut-out portions back into correspondence with each other, the turning direction of the whole device has to be reversed. To effect such reversal the guide plates 6 are braked by known means, not illustrated. Thereafter, only the ring gear 1 rotates until the cut-out portion 3 and 13 of the ring gear 1 and the guide plates 6 are substantially aligned with each other. When this occurs one of the drive bolts 38 and 39 (Figures 3 and 4), which is fixed to the ring gear 1, is urged by its respective biassing spring 41 into engagement with its respective stop bush 34 or 35 so as to take the guide plates 6 along with the ring gear 1.

Affixed to both sides of the casing cut-out portion 40 there are two centering shutters 20 (Figure 6) pivoted on swivel pins 23. These shutters 20 are movable by hydraulic or pneumatic actuators 21. Both the shutters 20 and the casing 31 are provided with centering elements 22 which, in the closed position of the shutters, make contact with the outer surface of the pipe 10 to be rotated, so that the exact centering is achieved.

The drive device is suspended in a derrick for movement radially relative to the pipe 10 to be rotated. Initially the centering shutters 20 are opened. The drive device is guided into position until the pipe lies between the shutters 20. By operating a valve the centering shutters 20 are closed, so that the centering elements 22 align the casing 31 with the rotational axis of the pipe 10. Finally, the ring gear 1 is driven by the pinions 2, in an anticlockwise direction as viewed in Figure 1, until the ramp surfaces 16a of the cams 7a and 7b press the jaws 9a and 9b against the pipe 10, when the pipe will be clamped relative to the ring gear 1 for rotation therewith. The cut-out portions 3 and 13 in the ring gear 1 and the guide plates 6 will be displaced through about 180° relative to each other, so that a very firm, closed ring is formed which can bear high loads, (Figure 1).

In order to bring the openings or cut-out portions 3 and 13 of the ring gear and the guide plates into alignment again, which is a necessary pre-condition for removing the drive device from the pipe, the direction of rotation of the ring gear 1 is reversed. The ring gear 1 is rotated in a clockwise direction until the respective openings or cut-out portions 13 and 3 of the guide plates 6 and of the ring gear 1 are substantially aligned with each other. In this position the spring-loaded bolt 39 engages its respective stop bush 35. Consequently, upon further clockwise rotation of the ring gear 1, the guide plates 6 are also driven on, until the cut-out portions 3, 13 and 40 of the ring gear 1, the guide plates 6 and the casing 31 respectively are aligned with each other. Thereupon both the pins 36 and 37 will be so lifted by the cams 32 and 33 that the bolts 38 and 39 will be disengaged from the stop bushes 34 and 35, leaving the ring gear 1 free to rotate relative to the guide plates 6 in either direction.

If required the ring gear 1 can then be rotated further in the clockwise direction until the rollers 8a and 8b of the clamping jaws 9a and 9b abut the surfaces 16b of the cams 7a and 7b to cause the grippers 15 to engage the pipe 10. Release of the device from the pipe requires anti-clockwise movement of the guide plates 6 with the ring gear 1. This is effected by the bolt 38 engaging with the guide bush 34.

Removal of the drive device according to the invention is effected after alignment of all the openings or cut-out portions 3, 13 and 40 and subsequent opening of the centering shutters 20, whereupon the device can be removed from the pipe in a radial direction. The operation of having to push the pipe against the shutters 20 in order to effect manual opening of the shutters is no longer necessary, and the danger of an accident in carrying out this previously necessary operation is avoided. Adaptation of the drive device to different pipe diameters is easily effected by interchanging the centering elements 22 on the shutters 20.

WHAT WE CLAIM IS:—

1. A rotational drive device for rotating a pipe, for example, a casing pipe for boreholes, comprising a ring gear coupled to a driving pinion, the ring gear having a cut-out portion and being disposed between two annular guide plates coaxial with said ring gear each of which has a cut-out portion of the same width as that of the ring gear, clamping jaws adapted to grip the pipe and guided for movement radially between the guide plates, cams arranged on the inside of the ring gear for displacing the clamping jaws radially relative to the guide plates, each cam and respective clamping jaw cooperating therewith being displaced axially relative to the or each other cam and respective clamping jaw so that each cam can only come into contact with its associated clamping jaw, and means for centering the pipe within the ring gear with the cut-out portions of the ring gear and the guide plates aligned with each other, the ring gear being rotatable relative to the guide plates, in either direction of rotation, until the cut-out portion in the ring gear is displaced by substantially 180° relative to the cut-out portions in the guide plates and a closed rigid ring-shaped structure is formed which is clamped to the pipe by the clamping jaws, whereupon further rotation of the ring gear in the same direction rotates the pipe.

2. A device according to Claim 1, including a casing having a cut-out portion, the casing being provided on both sides of its cut-out portion with lifting cams, each having two inclined cam surfaces facing in opposite circumferential directions, axially displaceable pins arranged in the said plates, and respective bolts axially displaceable in the ring gear by means of the respective pins to release the bolts from engagement with locking elements carried by the guide plates, so as to permit rotation of the ring gear relative to the plates.

3. A device according to Claim 2, in which each of the locking elements comprises a stop bush having one portion which faces in a circumferential direction removed so that the stop bushes are engageable by respective bolts when the associated pins are disengaged from the lifting cam surfaces.

4. A device according to Claim 3, in which the stop bushes and bolts are arranged in cooperating pairs, one pair effecting clockwise rotation of the guide plates and the other pair effecting anti-evockwise rotation of the guides plates, the bolt and stop bush of each pair having bevelled or cut-out surfaces such that each bolt can ride over the bush of the other pair.

5. A device according to Claim 3, in which the lifting cams, and the respective movable pins, bolts and stop bushes associated therewith are arranged at different radial distances from the axis of rotation of the ring gear such that they can pass one another during rotation of the guide plates.

6. A device according to any one of Claims 2 to 5, in which on opposite sides of the cut-out portion of the casing hydraulically or pneumatically movable centering shutters are arranged for centering the pipe to be driven relative to the ring gear, the plates and the surrounding casing.

7. A device according to Claim 6, in which each centering shutter is provided with a centering element engageable with the outside of the pipe.

8. A rotational drive device for rotating a pipe, substantially as herein described with reference to and as shown in the accompanying drawings.

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Sheet 1

FIG. 1

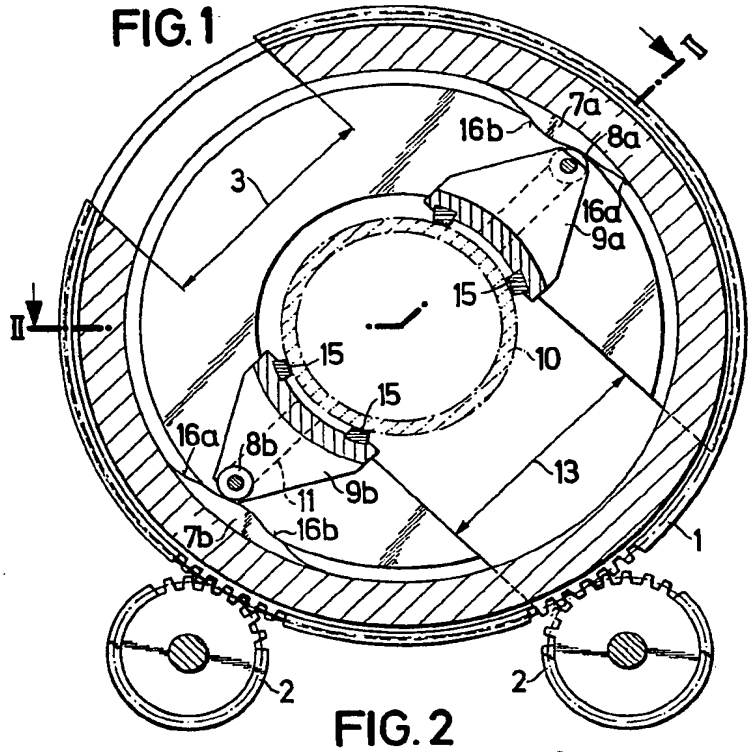

FIG. 2

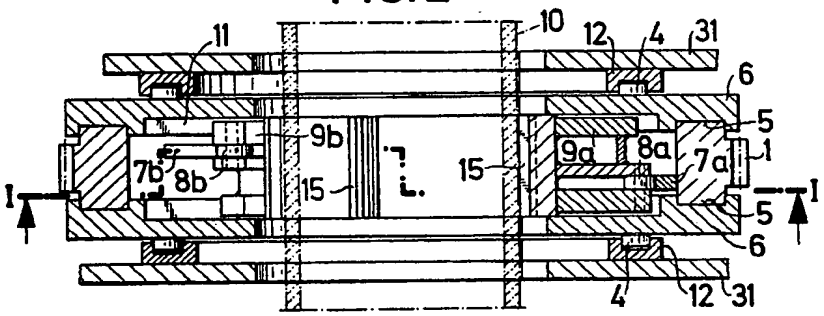

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FIG.3

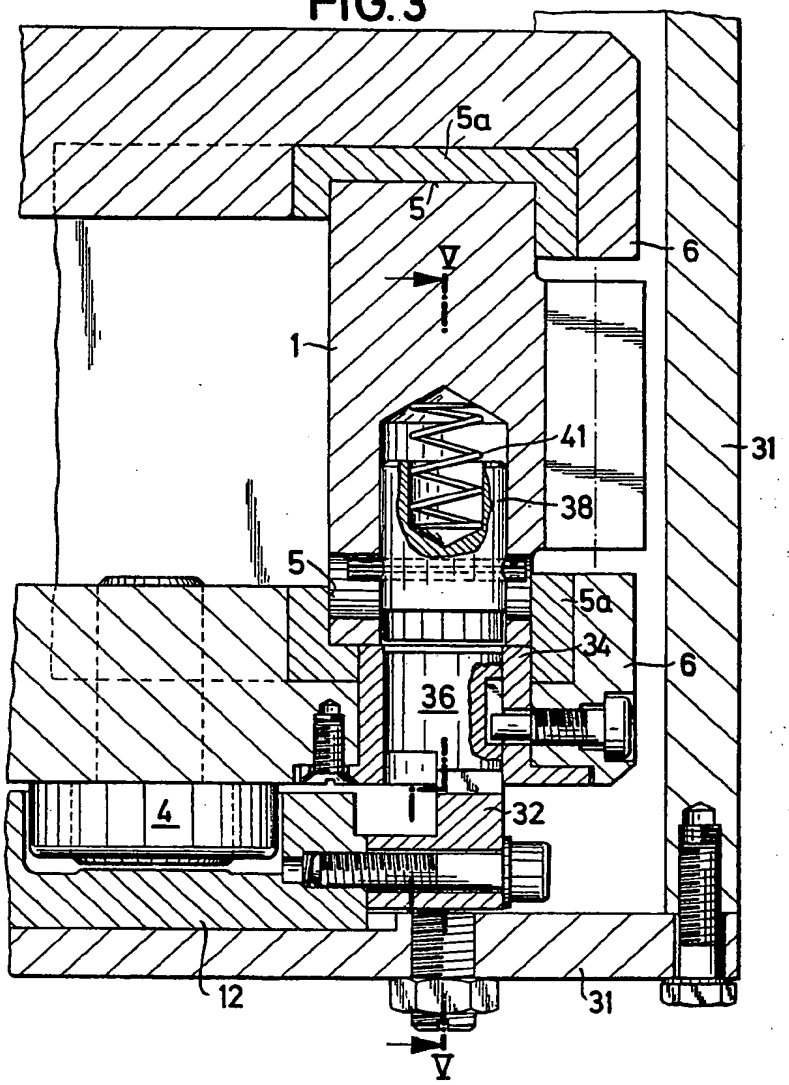

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FIG. 4

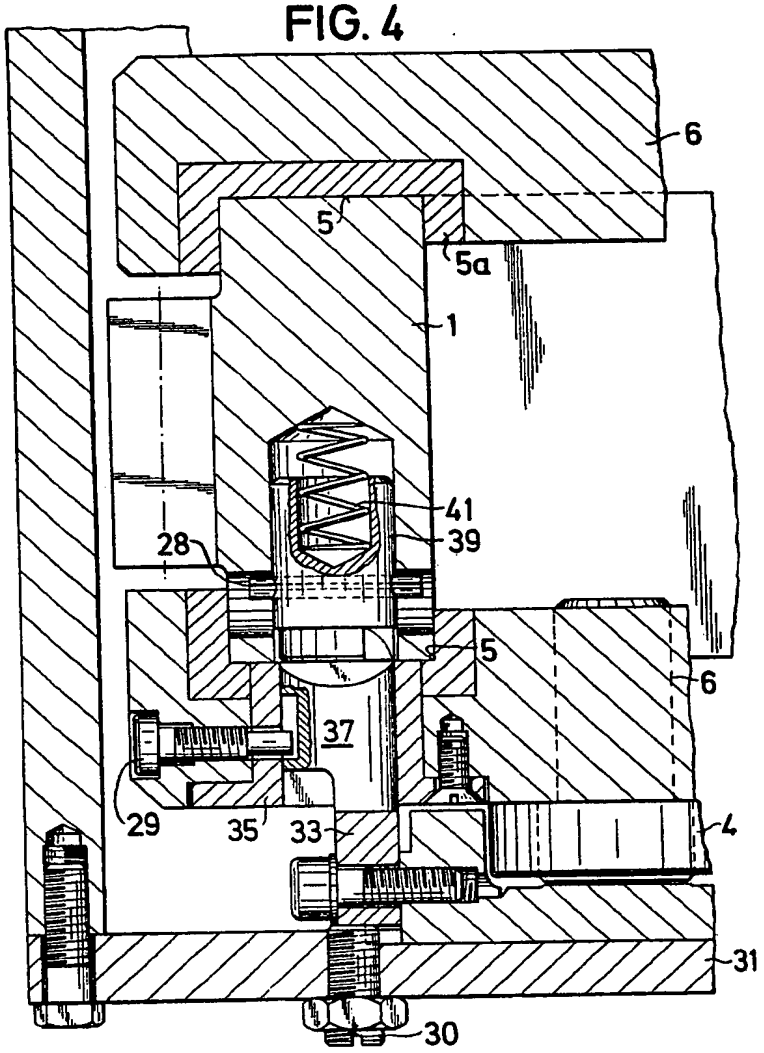
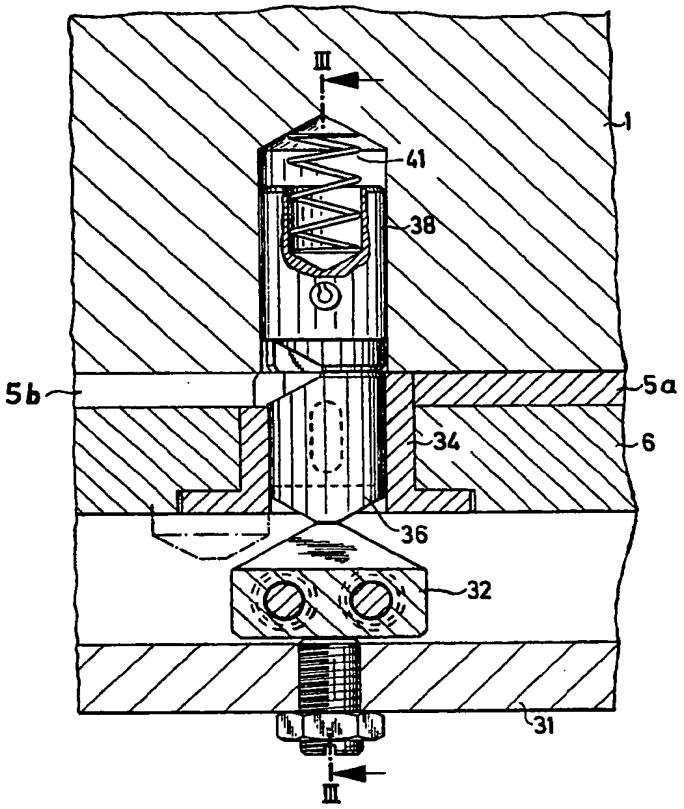


FIG. 5



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Sheet 5

FIG. 6